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ABSTRACT

In order for a remedial or supplemental mathematics laboratory program to be successful, several important elements must be present. Administrative support of the philosophy of the lab is essential before a sufficiently flexible budget will be provided. Student oriented personnel are the single most important factor in the success of the math lab. Positions usually should include instructors, lab supervisor, peer tutors and clerical help. Effective curriculum design is determined by the type of program and the needs of students. Placement tests such as the mathematical portion of the CAT (California Achievement Test) can be used to screen and place enrolling students. Post-evaluation tests and testing for subject matter retention are essential to determine whether the objectives of the lab are met. Flexibility in design and equipment in the lab will enable the utilization of various types of media as opposed to being restricted to a particular type of software. One of the most prevalent deficiencies noted in math labs is the absence of professional counseling; many learning problems not instructionally related can be more effectively dealt with through professional and vocational counseling. Motivational devices, such as mathematically related games, will stimulate interest and counteract negative attitudes which remedial labs sometimes create. (KJC)

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PLANNING AN EFFECTIVE MATH LAB

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PLANNING AN EFFECTIVE MATH LAB

Modern technology has brought about the introduction of much new terminology in education, either directly or as a spin-off. Such terms as programmed instruction, individualized instruction, self-paced instruction, computer assisted instruction, dial access instruction, and media oriented instruction are but a few of the plethora of terms that are banded about in today's academia.

At the outset our position, and the position supported by this paper, is to be made clear; that the most effective instruction for the total student population is that involving a close student-teacher relationship. It is the development, if you will permit, the extension, of that relationship that is the concern of this paper. The math laboratory is a special case of the student-teacher relationship, it limits the discipline to one particular area; mathematics, and the physical and sociological parameters are, for the most part, unlike those found in the traditional classroom. The parameters described herein are written in terms of remedial mathematics, although this distinction applies, with minor exceptions, only to the section on faculty and counseling.

There are certain elements upon which the success of a math lab depends. These elements will be discussed in the following

format:

- Administrative Support
- Personnel
- Curriculum Design
- Flexibility in Design and Equipment
- Professional Counseling
- Motivational Devices

Several of these components are either totally or partially beyond the control of the laboratory director. However, if the funds are available, personnel, materials, and equipment should be administratively controlled by the math lab personnel. Fig. (1) illustrates some of the elements of an individualized program.

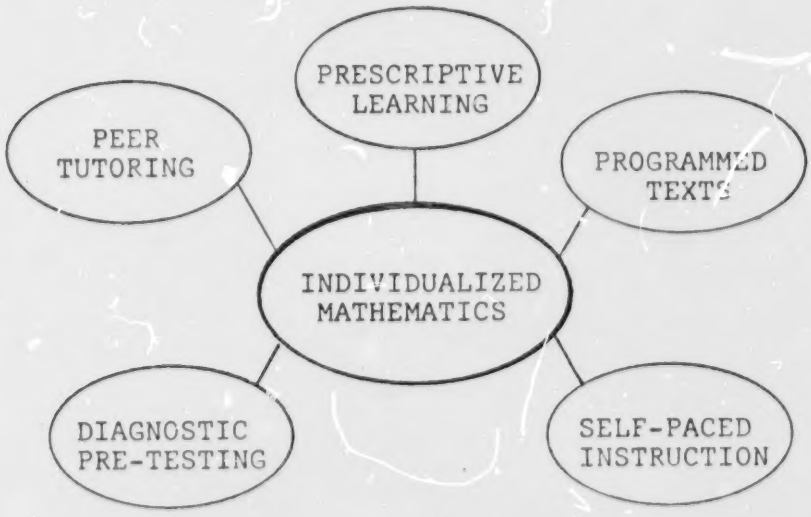

Fig. (1)

Administrative Support:

Financial Support: The beginning of any math lab is somewhere in the budget. Since budgets are ultimately controlled by the administration, administrative support is necessary before the math lab can appear even on paper.

Philosophical Support: The math lab is programmed for failure or mediocrity unless it is philosophically supported by the administration. The program must be assured of a commitment that permits it to adjust and modify to fit the unique needs of the institution in which it is founded. The freedom to make mistakes must exist.

We would never assume to write the recipe by which an effectively operating math lab can be "cookbooked." Conversely, we are presenting those conditions which, when satisfied, will ensure the development of a successful laboratory. Flexibility is one of these essential ingredients, and flexibility is provided only when the administration shares the philosophy of the mathematics laboratory.

Personnel:

The structure of the math lab is as varied as the number of labs. Each lab must be clearly defined in order to understand the personnel structure of that lab. However, there are several personnel positions that are common to most math laboratories. These positions include instructors, lab supervisor, peer tutors and sometimes clerical personnel. Two of these titles merit definition. The laboratory supervisor need have

no more than a bachelor's degree in mathematics, with the ability to supervise the peer tutors and clerical personnel. Ideally, this person works a 35-40-hour week in the lab. The peer tutor is a student with the ability to assist other students with their math lab work.

One of the greatest downfalls of a math lab, that would otherwise have the elements prerequisite to success, is the assumption, and subsequent assignment based upon that assumption, that a good instructor in the traditional classroom will be a successful instructor in the math lab. The math lab instructor must be keenly sensitive to the needs of students. This instructor must remember that a majority of the remedial students in the math lab are failure oriented; many others have been away from school long enough to have lost confidence in their abilities. The non-remedial student is working under new circumstances that may lack the sociological enforcement of the traditional classroom and, hence, must find new group associations in the math lab. Each contact between the instructor and the student should result in a positive reinforcement for the student.

It is most imperative that those persons who come in direct contact with students be student oriented. They must be prepared to spend the majority of the day with their students, as opposed to working alone in their offices. They must be able to perceive needs and to seek out students who need help. Many of these students are extremely reluctant to ask for assistance.

Usually the lab supervisor teaches the majority of math lab students. The supervisor's desk should be in the math lab so the supervisor is readily available. Duties of the lab supervisor include insuring that an individual folder is kept current on each student. The lab supervisor interviews and screens the tutors. Once the tutors are hired, the lab supervisor arranges their work schedules and indoctrinates them in successful tutoring. Since many labs also act as clearinghouses for private tutoring, the lab supervisor maintains a list of qualified tutors.

Peer Tutoring: Instructors sometimes forget the barrier that the "power of the grade" can create in terms of effective communications. Peer tutoring avoids this problem; students are more relaxed with their fellow students. As with any instructional person, students must respect the tutor if they are to learn; so careful tutor screening is a definite requirement.

We strongly believe in the value of peer tutors; however, we also recognize that they are young, inexperienced and require close supervision. The lab supervisor should maintain constant surveillance of the entire lab and be able to assist tutors when they require help.

Personnel are the single most important factor in the success of a math lab. Tutors should be recommended by the mathematics department faculty; thus, one is assured of their preparation in mathematics. They then should undergo a careful screening by the lab supervisor to determine their suitability for tutoring. Stress the importance of the tutor being able to distinguish

between what they do and do not know and insure that they tell the student when they do not know how to work a certain problem. Of course, they then should seek help from the lab supervisor. A pleasant personality and the ability to communicate are qualities required of all math lab personnel, along with having empathy for the needs of others. A tutor should never appear condescending toward a student.

About Tutoring is published by the National Association of Tutorial Services. Tutors will benefit from reading each issue of this publication.

Through an in-service training program you can insure that your tutors are familiar with all of the materials in the lab and that they know how to operate all the media devices.

In a tutor orientation you can stress certain tutoring techniques such as beginning a tutoring session by asking the student (a) to discuss his difficulty, (b) to show the tutor what work he has done, and (c) to discuss specific problems encountered in the text.

There are many typing and filing chores which are so necessary to a successful math lab. Student workers from a secretarial science program can often be employed for these tasks.

Curriculum Design:

Gurley [3:1] reached the conclusion that "In general, small group instruction is more effective than either independent study or traditional instruction in improving developmental writing skills." It is suggested that this conclusion can appropriately

be extended to the teaching of mathematics and that it should influence the curriculum design of the math lab.

The math lab can effectively operate along two basic approaches:

(1) Supplemental laboratory. The student is referred by the instructor or voluntarily comes in for help in a specific area. When the student arrives in the lab, his needs are diagnosed and materials appropriate to his needs are provided. When the student completes the work assigned, an evaluation of his progress is provided to the instructor.

Many types of self-instructional materials are available to the student in the lab. Strive to offer a variety of alternate learning path materials such as programmed texts, texts supported with audio tapes or filmstrips or 35mm slides.

(2) Scheduled class (maximum of 15 students). Students should be allowed to elect to take the remedial math lab if they feel unprepared for regular mathematics courses. However, if an entering curriculum student scores less than 14 on the mathematics portion of the ACT or less than 10th grade on the mathematics portion of the California Achievement Test (CAT), he should be required to take the remedial math lab before going on to the regular mathematics courses. Obviously, these scores are only guidelines. Fig. (2) is a flow chart of the math lab program.

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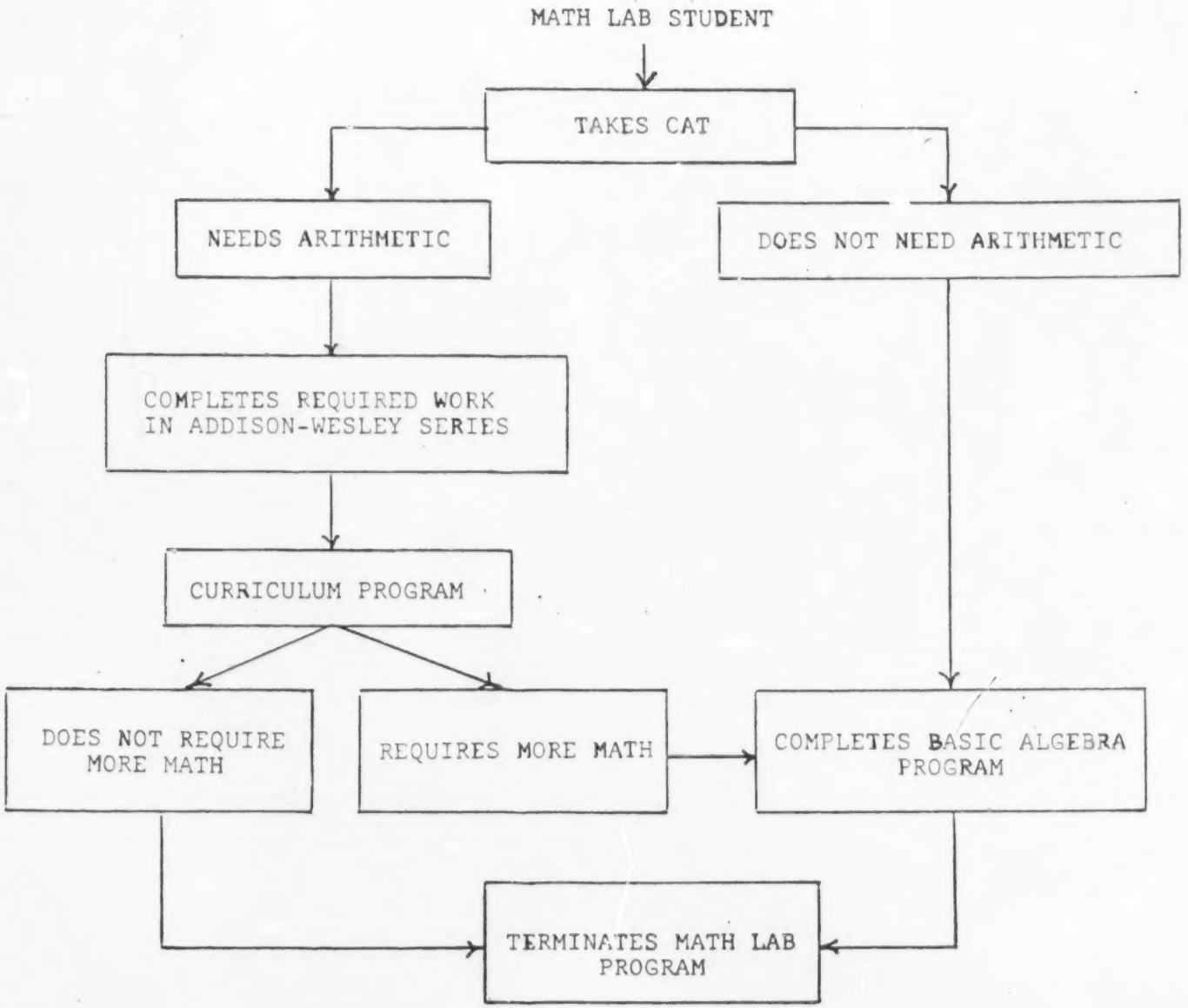
MATH LAB STUDENT
TAKES CAT
NEEDS ARITHMETIC
DOES NOT NEED ARITHMETIC
COMPLETES REQUIRED WORK IN ADDISON-WESLEY SERIES
CURRICULUM PROGRAM
DOES NOT REQUIRE MORE MATH
REQUIRES MORE MATH
COMPLETES BASIC ALGEBRA PROGRAM
TERMINATES MATH LAB PROGRAM

Fig. (2)

All math lab students should take the math portion of the CAT, either as a screening instrument prior to enrolling in the course or after having been placed in the course by some other means. The CAT provides the basic diagnosis to determine if the student is ready for basic algebra or if he requires background work in arithmetic. A need for arithmetic is indicated when his scores, as recorded in blocks A - G of the CAT test form, are less than:

A	B	C	D	E	F	G
11	4	4	14	14	14	14

or when the grade level equivalent on the CAT is less than grade nine.

If the CAT indicates a need in arithmetic, the diagnostic pre-test on Module I (whole numbers) of the Addison-Wesley Arithmetic Series is given. A plan of study is devised for one module at a time.

The content of the instructional materials in the math lab should range from basic arithmetic to statistics and calculus. Of course, you may not teach all these subjects in the math lab. The other course materials are used for tutoring and supplemental instruction. A word of caution is suggested when selecting the materials for your math lab. There is a vast array of materials available, but the ratio of worthwhile materials to others is quite low. Frequently you will want to evaluate your materials and the degree to which they assist in accomplishing your learning

objectives. When audio tapes are used, we suggest a program that offers the audio tape as a supplemental aid to the programmed text. There are other aspects that we consider essential to a basic algebra program. It should offer the capability to plan a prescriptive program of study as the result of a diagnostic pre-test, or tests, and should provide a comprehensive evaluation upon completion of the program. The post-evaluation should relate to the pre-test in order that change and final exit level can be measured.

Many programs have a weakness in that they do not obtain a total comprehensive measure that reflects some degree of retentive ability. The practice of retesting for mastery requires the student to demonstrate a certain level of proficiency before proceeding to the next unit of work. This practice, as illustrated in Fig. (3), sometimes means that the student retests two or three times on a given unit. It is not suggested that this practice be changed; what is suggested is that the possibility exists for students to eventually pass a given unit of work more through practice than understanding. To maintain some degree of academic integrity we must provide evidence of subject matter retention.

Math labs provide a service function. The recipients of this service range from the students to the departments that will instruct the student in work dependent on the preparation received in the math lab. If the math lab is to be creditable, it must be able to exhibit a satisfaction of the objectives it claims capable

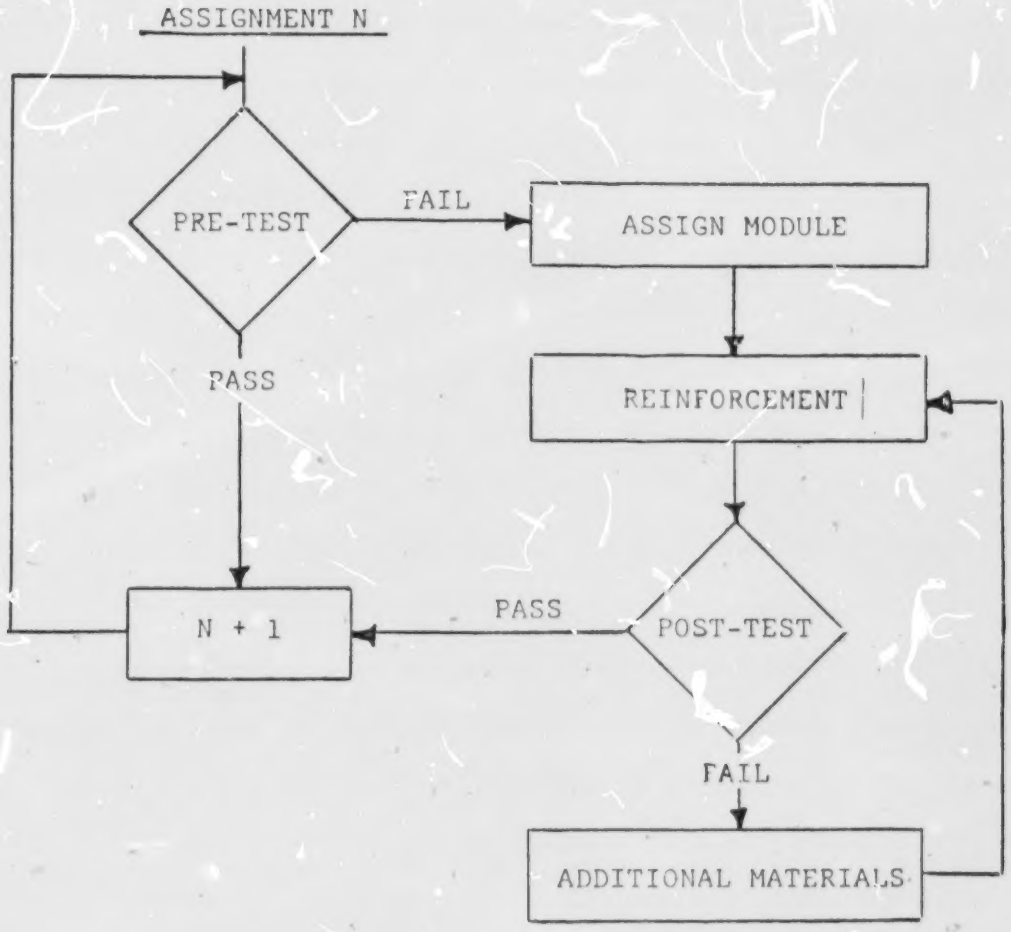
ASSIGNMENT N
PRE-TEST
FAIL
ASSIGN MODULE
PASS
REINFORCEMENT
N + 1
PASS
POST-TEST
FAIL
ADDITIONAL MATERIALS

Fig. (3)

of fulfilling. One way of doing this is through the use of standardized exams, the results of which are somewhat above question.

The McHale-Witzke Arithmetic Series, used in connection with the CAT, satisfies the requirements for a good lab program. First, it begins with whole numbers at a basic non-tactile level. The material is presented in a manner quite acceptable to adults. There are many tests offered with this program; the tests vary from diagnostic to unit tests, to comprehensive tests over the entire series. The diagnostic tests provide ease in prescriptive teaching, and the individual modules offer economy to those students who do not require the entire program.

As with any viable program, ours has had some problems. One of the most serious is the number of incomplete grades that we have given each semester. There are at least two factors contributing to this problem. First, we have continual enrollment in the math lab. A student can drop a regular math class at any time and add the math lab. Hence, we have students adding the class as late as the last few weeks of the semester. This factor is readily identified and accepted by all concerned since continual enrollment is encouraged in our program.

The second factor is not so readily identified, but it involves the individual nature of the program, proper administration (at the instructor level), and the immense amount of work on the part of the instructor. Most instructors who have taught both in the traditional lock-step classroom and the completely

individualized program will agree that, when done properly, the individualized program approach is more demanding on the instructor's time. The following is a set of hypothetical guidelines that might be provided to a math lab faculty.

(1) Prescriptive Student File:

(a) A file will be established on each math lab student.

(b) Initially the file will reflect the results of the prescriptive pre-test. The results will show the student's entry abilities and development needs. These needs must be translated into behavioral objectives.

(c) A precise prescriptive plan of study will be designed. This plan will be in terms of the behavioral objectives to be completed. The plan of study will extend to the exit point which will be defined for each student in terms of their goals.

(d) Each student will be given an individual one-to-one interview during the first week of class. During the initial interview the student will be apprised of the overall program and the planned time frame for completing the program. The time frame will reflect the magnitude of the program (behavioral objectives to be accomplished) and the student's individual learning rate.

(e) Each student's file will be reviewed, with the student, every three weeks. The review will determine the student's progression in terms of the plan initially designed for the student. The plan will be amended, if necessary, with each review. The student's file will reflect all reviews, the completion of objectives, all revisions, and any counseling sessions. The file will be treated confidentially.

(2) Attendance and Scheduling:

(a) It has been, and it will continue to be, the policy of the math lab to afford the greatest possible degree of flexibility to students in terms of scheduling needs.

(b) Flexibility is not to be confused with laxity. Students will be scheduled, as much as possible, in terms of their needs. However, once the agreed on schedule is fixed, strict adherence thereto will be required. This is not to say that schedules cannot be revised. Basically, we are saying that a minimum of three hours per week will be required in the mathematics laboratory. Additional sessions may be assigned when a student's review indicates less than satisfactory performance.

(3) Measuring Change:

(a) Just as prescriptive entry measuring instruments

will be used in the program design, instruments will also be used to ascertain student change (progress) and to establish the reliability of the program.

(b) Both comprehensive pre-tests and comprehensive post-tests will be administered. The results of the two tests will establish the change occurring in the student.

(c) One of the criticisms of math lab programs has been that objective attainment has been in terms of individual objectives but never in terms of comprehensive retention. The comprehensive post-test will establish the attainment of exit level objectives of a comprehensive nature.

Flexibility in Design and Equipment:

Many of you have, or will, begin your math lab with what space is available. Should you be fortunate enough to plan a new facility, the following suggestions may be helpful.

Basically, the lab should have carrels that permit the application of various media devices to support the programmed text, tables where the instructor or tutor can work with the students, a lab supervisor station raised for observation, and small classrooms where the instructor can hold discussions with small groups (less than ten) of students.

A wide assortment of equipment is in use in various math labs, and most of the users seem pretty well satisfied. The

particular equipment design is not as important as having the kinds of equipment that insure flexibility. The equipment should enable the utilization of various types of media as opposed to being restricted to a particular type of software or perhaps a single company's products.

The following comments indicate the equipment in the Alvin Community College math lab. This equipment serves us well, but it is not suggested that you need identical equipment to be successful.

We use a carrel-to-student ratio of 1:30. About one-eighth of the carrels are equipped with Kodak Model AF-2 slide projectors. All are equipped with a Wollensak Model 2505 or 2555 cassette tape player. All of the carrels have a 90° offset projection ability in addition to a built-in screen. The carrels can be equipped with filmstrip viewers and filmloop viewers. These viewers are available from the lab supervisor.

Sony video tape player-recorders are available so that any mathematics program available on the educational T.V. channel can be taped for use in the lab. We also have storage for a number of video cassettes that will be needed over a long period of time.

Our math lab is located adjacent to the library; hence, the microfilm reader is convenient for those students who need textbook material stored on microfilm.

The tape duplicator is in constant use. Students are allowed to check out copies of tapes; however, they must be returned.

Professional Counseling:

Roueche and Kirk [7], in their book on remedial education,

list effective counseling as one of the essential ingredients of a successful remedial program. One of the most prevalent deficiencies noted in math labs is the absence of professional counseling.

There are many causes for academic failure. Some of these causes can be successfully dealt with by the instructor. Others, however, require the assistance of professional counselors. Counselors should handle the problems resulting from emotional disorders as well as vocational counseling. Many remedial students have unrealistic goals, unrealistic in terms of their abilities. The instructor or lab supervisor, because of their close contact with the student, is in an excellent position to perceive these problems and bring them to the attention of a counselor.

Motivational Devices:

Motivation has always been the unknown quantity in education. We don't pretend to have found the panacea to this ill. What we do suggest is that any element that can be introduced into the math lab, that increases the student's interest in being there and causes him to look forward to going there, will enhance the overall success of the laboratory.

The objective is to create some esprit de corps and to counteract any negative attitude that remedial labs sometimes create.

We look for skill devices that can be expected to stimulate the mind whether they are directly related to mathematics or not. Such games as chess, go, and the WFF'N Proof [13] games of On Sets, Equations, and Tri-Nim are examples of stimulating and inexpensive

games that can be housed in the math lab. The game area should be located in a place that will not offer distraction to the instructional area.

IN CONCLUSION:

Our program has enjoyed some success. Followup studies show that 80% of those completing our program make a grade of "C" or better in subsequent mathematics courses. Similar studies have shown that the mean pre-test and post-test scores on the CAT were, respectively, 8.6 and 11.3 for an improvement of 2.7 grades. We have also administered the Aiken-Dreger Revised Mathematics Attitude Scale. On this scale, 40 is considered neutral, while less than 40 indicates a negative attitude and more than 40, a positive attitude. The mean pre-test score was 35.6 and the mean post-test score was 48.9. We believe the lab environment has contributed to an attitude change from negative to positive.

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11. Lansford
P.O. Box 8711
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1540 Page Mill Road
Palo Alto, California 94304
(Math Kits)

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